

## A new crawfish of the genus *Procambarus* (Crustacea: Decapoda: Cambaridae) from central Texas

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*Abstract.*—*Procambarus* (*Girardiella*) *ceruleus* is a new burrowing crawfish known from two localities in the Brazos River drainage of Brazos County, Texas. Although it shares many key characters with the members of the Gracilis Group of the subgenus, the following combination of characters will distinguish the species: presence of cephalic process in the male; prominent caudal knob surmounted by conspicuous caudal process in the male; unbearded palm; narrow areola; rostrum lacking marginal spines or tubercles; and female annulus ventralis that is subcircular in outline.

After a period of comparative neglect, the crawfish fauna of Texas has recently received the attention it deserves. Of the 20 crawfishes described since Hobbs' (1989) checklist, six were from type localities in Texas, more than from any other state. Other, longer studies have since been based on Texas materials (Hobbs 1990, Hobbs & Whiteman 1991, Fitzpatrick & Suttkus 1992). In addition, recent collections by David Hillis and his associates have indicated the presence of several undescribed species, especially among the burrowing forms (Keith A. Crandall, in litt.), and students of one of us (MKW) have provided records of other previously unknown crawfishes. The description that follows represents one of the latter.

The following abbreviations are employed: TCL, Total Carapace Length; PCL, Postorbital Carapace Length; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D.C.; TU, Tulane University Museum of Natural History, Belle Chasse, Louisiana.

*Procambarus* (*Girardiella*) *ceruleus*,  
new species

Fig. 1

*Diagnosis.*—Body pigmented; eyes well developed, faceted and pigmented. Rostrum

slightly depressed; margins not conspicuously thickened and without marginal spines, somewhat rounded cephalically and tapering to small rounded acumen; lacking median carina. Carapace without cervical spines. Areola 10.3 to 14.8 (average 12.4) times longer than wide, constituting 37.9% to 43.1% (average 40.1%) of TCL and 44.3% to 46.6% (average 45.8%) of PCL. Suborbital angle small but obvious; hepatic region of carapace sparsely granulate; branchiostegal spine small but acute. Antennal scale about 1.8 times longer than broad, widest distal to mid-length, with thickened lateral portion ending in stout spine. Mesial surface of chela not bearded, with row of 6 to 8 spiniform tubercles, which are flanked dorsally and ventrally by row of smaller and less numerous tubercles; ventral surface slightly tuberculate; dorsal surface with scattered setiferous punctations; shallow notchlike excavation in proximal third of opposable margin of dactyl. Ischium of third pereopod of male with simple hook overreaching basioischial articulation and not opposed by tubercle on basis; coxa of fourth pereopod without caudomesial boss. First pleopods of first form male reaching coxae of third pereopods when abdomen

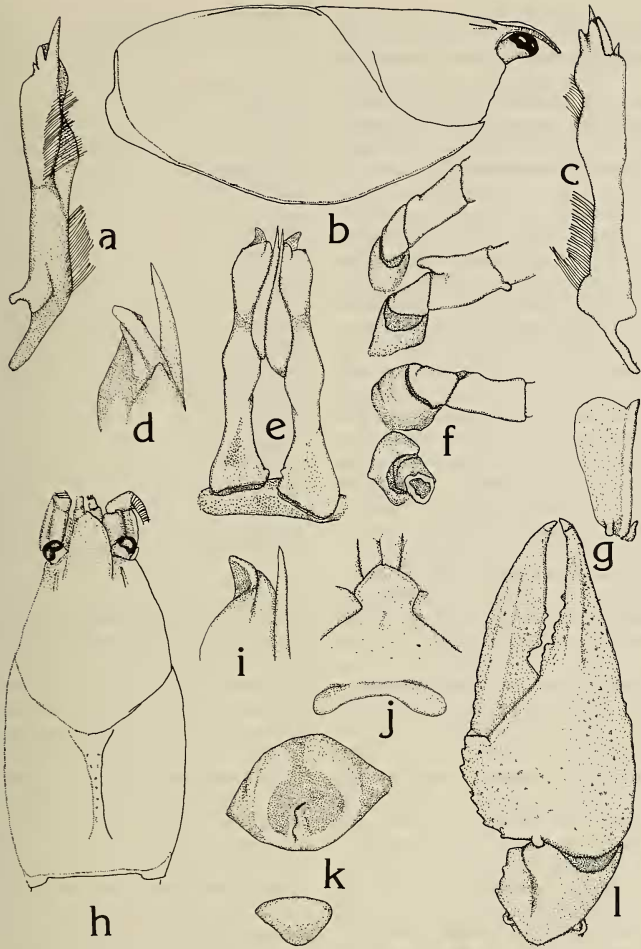


Fig. 1. *Procambarus (Girardiella) ceruleus*, new species (all figures of holotype, except *k* of allotype): *a*, Mesial aspect of first pleopod; *b*, Lateral aspect of carapace; *c*, Lateral aspect of first pleopod; *d*, Cephalic aspect of apex of first pleopod; *e*, Caudal view of first pleopods; *f*, Basal podomeres of left third through fifth pereiopods; *g*, Antennal scale; *h*, Dorsal aspect of carapace; *i*, Cephalic aspect of apex of first pleopod; *j*, Epistome; *k*, Annulus ventralis and postannular sclerite; *l*, Dorsal aspect of distal podomeres of right cheliped.

flexed, asymmetrical, bases not contiguous and with proximomesial spine; strong shoulder at cephalic base of terminal elements; lacking subterminal setae; terminal elements all sclerotized at least distally, consisting of straight, tapering, subacute, distally directed mesial process extending well beyond other elements; short, cephalodistally directed cephalic process somewhat separated from central projection; strong, flattened, caudodistally arched central projection, which strongly deflected laterally and barely overreaching prominent, distally directed, apically rounded caudal process. Annulus ventralis of female freely movable, about 1.4 times wider than long, with central depression surrounded by rounded smooth ridges; sinus originating slightly lateral to midpoint of annulus, then moving to midline where curving caudad and tracing gently sinuous path before terminating near caudal margin. Postannular sclerite small (annulus about 2.2 times longer and wider); preannular plate poorly developed; first pleopods present.

*Measurements of types.*—See Table 1.

*Holotypic male, form I.*—Cephalothorax (Fig. 1b, h) subcylindrical. Second segment of abdomen distinctly narrower than thorax (12.5 and 18.0 mm, respectively). Areola 12.1 times longer than wide, with single punctuation across narrowest part. Cephalic section of carapace 2.5 times as long as areola, latter constituting 39.2% of TCL (44.3% of PCL). Surface of carapace punctuate dorsally, having low tubercles in hepatic region, and with tiny granulations in extreme cephalolateral portion of branchiostegite. Rostrum slightly excavate dorsally, with converging margins (right side inflated, apparently by premortem injury) not ending in distinct shoulders or spines; median carina absent; acumen reduced to small tubercle. Subrostral ridges weak, scarcely visible in dorsal aspect. Suborbital angle small but distinct. Branchiostegal spine small but acute; cervical spine absent.

Abdomen shorter than carapace: Cephalic section of telson with single fixed spine

Table 1.—Measurements (mm) of type specimens of *Procambarus (Girardiella) ceruleus*, new species.

	Holotypic male, Form I	Allotypic female
Carapace		
Height	16.4	13.4
Width	18.0	14.9
Total length	33.9	30.6
Postorbital length	30.0	26.6
Areola		
Width	1.0	1.0
Length	13.3	12.1
Rostrum		
Width	5.5	6.6
Length	7.4	6.9
Chela		
Length of mesial margin of palm	9.8	6.2
Width of palm	13.4	7.3
Length of lateral margin	26.8	17.2
Length of dactyl	17.9	11.6
Abdomen		
Width	12.5	damaged
Length	29.1	damaged

in each caudolateral corner. Uropod with both lobes of basal podomere bearing stout subacute spine, mesial ramus with pre-marginal distomedian spine not overreaching margin and strong lateral spine; dorsal surfaces of both rami with submedian ridge proximally. Cephalic lobe of epistome (Fig. 1j) subovate in outline and without markedly elevated margins; fovea of main body of epistome scarcely visible; zygo-ma only mildly arched. Ventral surface of proximal podomere of antennular peduncle without spine near midlength. Antennal peduncle lacking spines on both basis and ischium; flagellum when flexed reaching to caudal margin of carapace. Antennal scale (Fig. 1g) 1.6 times as long as broad, widest distal to midlength; greatest width of lamellar part 3.9 times width of thickened lateral part.

Palpus of third maxilliped reaching almost to distal margin of proximal podomere of antennule; ventromesial and opposable surfaces of ischium and merus provided

with dense mat of plumose setae that totally obscure dentate opposable margins and mesial half of podomeres.

Right chela (Fig. 11) subovate in cross section, moderately depressed, palm 1.4 times wider than length of inner margin, dorsal surface studded with shallow, sparsely setiferous punctations; mesial margin with row of 8 strong spiniform tubercles, flanked dorsally by row of 6 smaller ones, and single small but stout tubercle ventral to mesial row. Both fingers with submedian longitudinal ridges dorsally and ventrally, dorsal ones flanked by numerous setiferous punctations. Opposable margin of fixed finger with row of 3 prominent tubercles in proximal third, distalmost largest, and band of minute denticles extending along distal half almost to corneous tip; large apically rounded tubercle ventral to denticle band near midlength of band. Opposable margin of movable finger with row of 5 tubercles in shallow excision in basal half, distalmost markedly larger; distal half with band of minute denticles extending almost to corneous tip.

Carpus of cheliped 1.4 times longer than wide, with conspicuous longitudinal furrow flanked by few punctations on dorsal surface; mesial surface with 4 small tubercles proximally and large spiniform tubercle near midlength; ventral surface with strong spiniform tubercle in mesiodistal corner and row of 3 such tubercles on laterodistal half of margin; conspicuous oblique, shallow furrow between row and mesiodistal tubercle, extending to near midpoint of podomere.

Merus with dorsal row of 10 tubercles, distalmost large and subspiniform, flanked laterally by row of 4 small tubercles; ventrolateral margin with row of 11 small spiniform tubercles and ventromesial margin with row of 16, tubercles in both rows increasing in size distally. Ischium with single tubercle dorsally just distal to midlength and row of 2 ventrally. Margins of basis and coxa entire.

Hook on ischium of third pereopod only

(Fig. 1f), simple, overreaching distal margin of basis but not opposed by tubercle. Coxae of third and fourth pereopods lacking boss.

Sternum of third through fifth thoracic segments deeply excavate and with long dense mats of plumose setae on ventrolateral margins, which setae masking most of length of first pleopods when abdomen flexed.

First pleopods (Figs. 1a, c, d, e, i) as described in "Diagnosis."

*Allotypic female*.—Differing from holotype, except in secondary sexual characters, as follows: Areola 39.5% of TCL (45.5% of PCL), with 1 or 2 punctations across narrowest part. Length of mesial margin of chela 1.2 times width of palm; mesial margin with median row of 6 tubercles, with only single tubercle flanking dorsally and none ventrally; ultimate tubercle on opposable margin of fixed finger of right side markedly larger than that of holotype. Annulus ventralis (Fig. 1k) with subcircular central elevations; deep cephalomedian trough dividing ridges and central depression making elevations imperfect ring; barest hint of tuberculation on cephalolateral crests of elevations. Otherwise, as described in "Diagnosis."

*Paratypic male, form II*.—Differing from holotype as follows: Areola 37.9% of TCL (46.4% of PCL) and 13.1 times as long as wide. Tubercles of mesial margin of chela more spiniform and with medianmost row of 7 tubercles, flanked dorsally by row of 5 and ventrally by row of 5. Acumen of rostrum much reduced by comparison, possibly broken and healed.

First pleopods with severe premortem damage; right scarcely reaching beyond base, left apparently about half typical length and with attenuate apex devoid of indication of terminal elements. Pleopods apparently similar to holotype in proximal parts.

*Color notes*.—Ground color basically light beige, mottled everywhere by fine blue-black to black spots. Spots coalescing

into larger ones on lateral branchiostegites, those in dorsal gastric region often conspicuously large. Light dorsomedian stripe on abdominal segments flanked by punctate stripe, and it flanked more ventrolaterally by angled dark stripe formed of close-set spots; pendulant parts of pleuron delimited by stripe intermediate in density between two aforementioned stripes. Telson and uropods uniformly mottled by fine spots. Chelae with dorsal surfaces of podomeres suffused with intense cerulean blue, and tubercles outstanding with blue-black coloration; large tubercles of opposable margins of fingers creamy white; tips of both fingers with encircling subdued dark red stripe. Coxae and bases of other pereopods paler cerulean color; more distal podomeres not strikingly different in patterns from body.

*Type locality.*—Burrows in a wet area of a horse pasture on Riley Road, Reliance community, 0.7 mi (1.4 km) east of Farm to Market (FM on maps) Road 1179, east of Bryan, Brazos County, Texas; latitude and longitude approximately 30°45'N, 96°14'W. Here the habitat is grassy pasture on a sand and clay soil. It has been used as a pasture for horses and cattle for at least 10 years. The area contains depressions that can hold rain water for weeks, but the entire area dries out in summer. The depressions contain taller grasses and sedges (family Cyperaceae).

*Disposition of types.*—The holotypic male Form I, and allotypic female are deposited in the National Museum of Natural History as USNM nos. 260824 and 260825, respectively; paratypes are in the Tulane University Museum of Natural History (TU 6814, 1 ♂I; TU 6815, 1 ♀; TU 6816, 2 ♂I; TU 6817, 1 ♂II [exuvium]; TU 6818, 1 ♂I, 1 ♂II).

*Specimens examined.*—With one exception, noted below, all specimens came from the type locality; Brazos County, Texas: (1) type locality, 24 Jun 1993, 1 ♂I, coll. M. K. Wicksten; 12 Jun 1994, 1 ♀, MKW; 25 Jun 1994, 1 ♂I [carapace and chela only] MKW; 12 Jun 1995, 3 ♂I, 1 ♀, MKW; (2)

Wolf Pen Creek at Gilchrist Avenue and Francis Street, College Station, 12 Jun 1995, 1 ♂II [broken exuvium only], MKW; 1 Jan 1995, 1 ♂I, 1 ♂II, James Self.

*Variations.*—There is little recorded variation other than slight differences in the numbers and comparative sizes of the tubercular and spinose ornamentation, especially of the chelipeds. Considering the sample size and geographic restriction of the type series, this is not surprising.

*Relationships.*—The presence of a cephalic process on the gonopod of the male places *Procambarus* (*Girardiella*) *ceruleus* in the *Gracilis* Section of the subgenus *Girardiella* as designated by Fitzpatrick (1978a). Within the group it has its closest affinities with *P. (G.) kensleyi* Hobbs (1990), *P. (G.) liberorum* Fitzpatrick (1978b) *P. (G.) nigrocinctus* Hobbs (1990), *P. (G.) curdi* Reimer (1975), *P. (G.) reimeri* Hobbs (1979), and *P. (G.) tulaneii* Penn (1953). It shares with these a broad cephalodistally directed caudal knob surmounted by a corneous conspicuous caudal process, and a more or less straight mesial process that extends beyond the other elements by at least their length. The narrow areola of *P. (G.) ceruleus* is approached only in *P. curdi* and *P. reimeri*; in *P. liberorum* the areola is obliterated. The annulus ventralis of the female, which is subcircular in outline, is most like that of *P. tulaneii*, but the latter species has a bearded mesial margin of the palm, as does *P. kensleyi*. The following combination of 6 characters will distinguish this species: presence of a cephalic process in the male; a prominent caudal knob surmounted by a conspicuous caudal process in the male; an unbearded palm; a narrow areola; a rostrum lacking marginal spines or tubercles; and a female annulus ventralis that is subcircular in outline. The characters that this new species shares with a large number of members of the *Gracilis* Group that were previously thought not so closely related suggests that a reevaluation of the phylogeny of this cluster of species

is in order, perhaps using molecular techniques.

*Ecological notes.*—The species apparently is a primary burrower, but the collections from the second site indicate that it, like many of its relatives, will venture into a stream or puddle, perhaps to breed or to feed. No data exist to indicate its breeding habits, but first form males were collected in June and January; no ovigerous females, no juveniles, and no females with a sperm plug were encountered. The largest animal, the form II male from Wolf Creek, is 44.8 mm TCL (36.6 mm PCL), and the largest and smallest form I males are 35.1 and 24.3 mm TCL (31.8 and 20.3 mm PCL, respectively) (the figures for the smallest are a close approximation because of damage to the caudal region of the cephalothorax). At the type locality, a juvenile male *Fallicambarus*, probably *F. (Creaserinus) fodiens* (Cottle, 1863) was collected on 12 June 1995.

*Remarks.*—One other feature merits mention. All specimens examined by us exhibited damage. Some was extensive and involved loss of a sizeable body part, others were slightly damaged; none of the specimens was missing chelae. Those from the type locality were collected on the surface of the soil after heavy rainfall, and it seems likely that the damage was due to the hazards of exposure on the surface. One of us (MKW) observed cattle egrets, *Bubulcus ibis*, foraging in the pasture on the same day that the crayfish were collected. Cattle egrets often eat crayfish. The pasture also contains numerous colonies of fire ants, *Solenopsis invicta*, which will attack any larger invertebrate that cannot escape quickly.

Some comment is necessary on the paucity of specimens and localities. Both are related to a social phenomenon of this section of the country. Almost all the land is fenced, posted and zealously defended against encroachment. Owners deny access to everyone and it is virtually impossible to obtain license to collect, much less to dig

holes that potentially could injure livestock. What is reported here is the limit of what we could secure between the first collection and the Fall of 1997.

*Etymology.*—*L., caeruleus*, sky blue; an allusion to the coloration characteristic of the cheliped of this species.

#### Acknowledgments

We would like to thank W. Tyler and Mary Moore, owners of the property where the crawfishes were collected, for their interest in the natural habitat and for permission to collect on their land. James Self donated the animals noted above. We also are indebted to John E. Cooper, North Carolina State Museum of Natural Sciences, who reviewed the manuscript.

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